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# NASA TECH BRIEF

## *Lewis Research Center*



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### Design Criteria Monograph for Pressure Regulators, Relief Valves, Check Valves, Burst Disks, and Explosive Valves

A design criteria monograph has been published which is a summary and a systematic ordering of the large and loosely organized body of existing successful design techniques and practices for pressure regulators, relief valves, check valves, burst disks, and explosive valves.

This monograph was written to organize and present, for effective use in design, the significant experience and knowledge accumulated by NASA in development and operational programs. It reviews and assesses current design practices, and from them establishes firm guidance for achieving greater consistency in design, increased reliability in the end product, and greater efficiency in the design effort.

The technology for aerospace regulators, relief valves, and check valves originated in commercial industry, where these units are used extensively; burst disks and explosive valves have the same origin but are used on a limited scale. For aircraft applications, commercial units were modified to reduce size and weight without loss of reliability and long life. The early space vehicles and engines employed many of the aircraft hydraulic-type controls modified for rapid response and operation in extreme vibration environments. The requirements of cryogenic oxidizers led to the development of new sealing methods and the use of high-pressure stored helium or nitrogen for pressurization and control functions. The advent of storable propellants necessitated the development of control components using materials compatible with exotic fluids.

Many problems in the design and operation of these devices in space vehicles are created by the stringent operational requirements and the severe service environments. The current proven reliability of these components in liquid rocket systems demonstrates the benefits of careful investigation to identify failure modes and extensive testing to prove the adequacy of the problem solution.

This monograph is based on a critical evaluation of the experiences and practices in the design, test, and use of these control devices in operational space vehicles. The material in the monograph is organized for natural and

effective use by designers. Each of the five devices is treated separately. For all of the units, the choice of optimum configuration is important, and guides to aid in configuration selection are outlined.

The monograph comprises two major sections: State of the Art, and Design Criteria and Recommended Practices. References complement the text.

The State of the Art section reviews and discusses the total design problem, and identifies the design elements that are involved in successful design. The Design Criteria state clearly and briefly each rule, guide, limitation, or standard that must be imposed on each essential design element to assure successful design; the Recommended Practices set forth the best available procedures for satisfying the Design Criteria.

Both major sections are divided into five subject categories: regulators (assembly, inlet valve, actuator, control elements, operational problems, leak testing), relief valves (size, assembly, inlet valve, actuator, control elements, operational problems), check valves (poppet, flapper, operational problems), burst disks (pressure, size and thickness, patterns, material, installation), and explosive valves (body, actuator, operational problems).

This thorough review of design criteria and practices relating to fluid controls should be of value to manufacturers of these fluid control devices, instrumentation manufacturers, and industrial processors.

#### Notes:

1. This monograph is available as the following report:  
NASA SP-8080 (N74-10724), Liquid Rocket Pressure Regulators, Relief Valves, Check Valves, Burst Disks, and Explosive Valves

Copies may be obtained at cost from:  
Aerospace Research Applications Center  
Indiana University  
400 East Seventh Street  
Bloomington, Indiana 47401  
Telephone: 812-337-7833  
Reference: B74-10010

(continued overleaf)

2. Specific technical questions may be directed to:

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